



Review

Cognitive activation theory of stress (CATS)

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ARTICLE INFO

Keywords:

Coping
 Helplessness
 Hopelessness
 Response outcome expectancy
 Activation theory
 Cognitive mechanisms

ABSTRACT

The cognitive activation theory of stress (CATS) is based on a long series of experiments on animals and on humans, in the laboratory, and in real life situations. From the common sense coping concept formulated by Seymour Levine; coping is when my “tommy” does not hurt, we have advanced to a systematic theory for what is behind the relaxed and happy coping rat (and cat). We also cover the translational leap to humans, starting with the now classic parachutist study. The bridge is based on formal and symbolic definitions, a theoretical short cut that Levine actually never really accepted. The essential pathophysiological concept is the potential pathological effects of sustained activation, which may occur in the absence of coping (positive response outcome expectancy). We review the current status of CATS in Behavioural Medicine by discussing its potential explanatory power in epidemiology, prevention and treatment of “subjective health complaints”.

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Contents

1. “CATS”	877
2. The relaxed and happy coping cat (and rat) (1960–1973)	877
3. The translational leap to humans – the parachutist study (1978)	878
4. The Levine–Ursin stress paper (1991)	878
5. The CATS paper: the expectancies (Ursin and Eriksen, 2004)	879
6. The CATS paper: sustained activation as a path physiological model	879
7. What happens when the “tommy” really hurts?	880
8. Sensitisation: the pathophysiology of sustained activation (“stress”)	880
9. Interventions	880
10. Conclusion	880
References	881

1. “CATS”

The development of “CATS” – the cognitive activation theory of stress, depends heavily on the collaboration between our Bergen group and Seymour Levine, from the time the collaboration started in 1970. The basic experiments and problems are of even longer standing. “CATS” is a result of a long series of experiments and theoretical papers, with data from animals and humans. Levine went along and was essential for many of the concepts in the theory, but did not share our enthusiasm for our use of formal, logical definitions. We could not convince him that this approach

may eliminate some of the problems inherent in comparing data from animals with data from humans (Fig. 1).

A formal version of CATS was presented by Ursin and Eriksen in 2004 (Ursin and Eriksen, 2004). The first version was published as a chapter in a book (Ursin, 1988), and received little, if any, interest. This early version had many of the formal and systematic definitions. In 1991 Levine and Ursin published a joint paper, with many of the same positions, but without the formal definitions. Finally, Eriksen insisted on a revision and rewriting of the paper, this time Levine was one of the referees. This time it has received interest, at least among European stress researchers.

2. The relaxed and happy coping cat (and rat) (1960–1973)

The point of departure for our concepts of “stress” is why an animal motivated by fear does not look frightened at all. This

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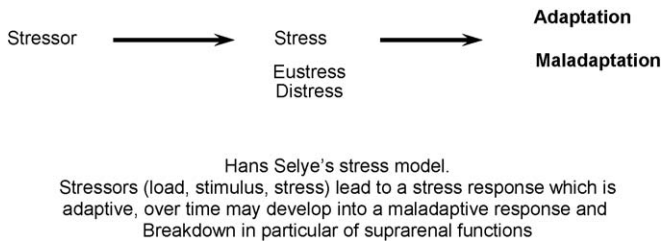


Fig. 1. The allostasis model is a further development, repeated use of the system produces some kind of strain in the long run.

question is related to why humans seek and apparently enjoy extreme and dangerous tasks. This has also led us to question many of the preventive and therapeutic approaches to common ailments (back pain, fatigue) generally believed to be necessary evil consequences of modern life and “stress”.

The behaviour of a cat that has learned avoidance behaviour is a remarkable contrast to that of a cat before it has learned the correct behaviour. It is also a very marked contrast to that of a feral cat confronted with a human, or the fear and defence behaviour elicited by amygdala stimulation (Ursin, 1965). During the early acquisition trials in an avoidance experiment, there is a high level of arousal, pupillary dilatation, piloerection, micturation, hissing, and growling. Once the habit is required, all this is gone. The cat jumps willingly into the test box, sits quietly between trials, purrs, grooms itself, and jumps graciously and in great calmness to the safe side of the apparatus. The cat certainly looks content, but how to measure it?

Many previous authors had commented upon the relaxed nature of the animals in late stages of avoidance. When the performance is approaching a level of perfection, the performance becomes stereotyped (“asymptotic”, “mastery”) with a decrease in overt emotional reactions (Solomon and Wynne, 1953). Within traditional learning theory, the reduction in overt fear is due to the avoidance responses, removing the animal from the fear stimulus. However, this reduction is so fast and efficient that it terminates the anxiety reaction before “it is more than minimally elicited” (Solomon and Wynne, 1954). We will give some examples of situations where the calmness and relaxation appear even without any response, only the possibility of performing a response if required.

In the early 1960s Ursin made some heroic attempts to measure the stress levels in the cats from blood samples obtained from implanted venous catheters, but the final analyses of cortisol were too unreliable to give any meaningful data. The technique of producing polyethylene tubes was not very good, either, at that time. The real progress for us came in 1970 when Gary Coover came to us from Seymour Levine’s laboratory in Stanford. Again, we saw the relaxed rats performing at a high rate of precision in the

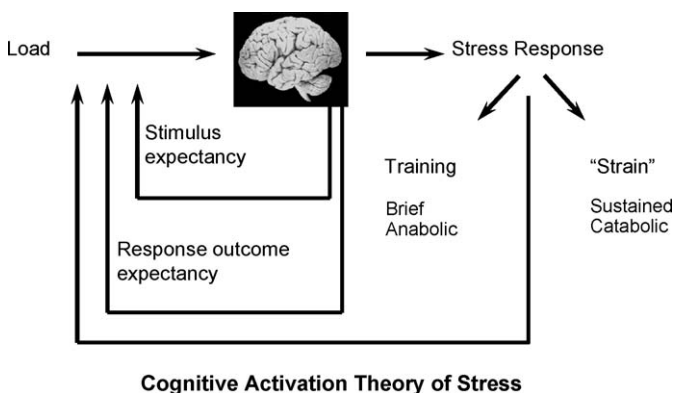


Fig. 2. The CATS model.

active avoidance apparatus. Now we were able to obtain blood samples, and to have them analysed by reliable methods in a high quality laboratory. Now we were able to demonstrate that the rat performing well in the avoidance apparatus, presumably motivated by “fear”, showed no signs of fear other than the avoidance behaviour, and that the rat had the corresponding low values of corticosterone in plasma (Coover et al., 1973). We described the animal as “a minimally aroused, behaviorally relaxed, coping rat”. Since then we have worked with this coping concept, which is different from the “coping attempts” of Weiss (1968), and different from the “Ways of Coping” (WOC) of Lazarus (1966).

3. The translational leap to humans – the parachutist study (1978)

The next question was whether these data transfer to humans. What happens in humans, faced with a frightening and potentially dangerous task, when the proper behaviour is established? If similar conditions exist for humans, this would have important consequences for the general and popular beliefs that somehow “stress” is bad for you. Ursin et al. (1978) tested this position in an experiment with parachutists. In a training tower situation, the subjectively reported fear, and the vegetative and endocrine responses to the jump, was reduced after the first training sessions, long before their performance had reached any acceptable level. It was not the performance, or the feedback from evaluation of the performance, that mattered, it was the subjective feeling of being able to perform that reduced the stress responses.

In the resulting book from this study, we struggled with the “coping” concept. It had not been used much before, in the animal literature we only found Weiss (1968), but he used the term for “coping attempts”, and claimed that numerous coping attempts, in the absence of feedback, would result in stomach ulcers and a depletion of noradrenalin in the brain. Lazarus (1966) used the term also for coping attempts and coping strategies. We needed a term for the psychological and physiological state when the individual expects to be able to cope with the challenge. Levine formulated this as coping is “when my stomach does not hurt” (Ursin et al. 1978). A more sophisticated version came in 1991.

An important sideline from this study was the relevance of psychological defence mechanisms for cortisol reactivity. This work developed further, but independent of our collaboration with Levine. Psychological defence mechanisms, as they are measured in the Kragh tachistoscopic test (Olf et al., 1990), predict performance, but only in life threatening situations. A collaboration was established with Dutch researchers with support from funds from the European Union (Olf et al., 1990, 1991). Eriksen has pursued this line further, demonstrating basic neurophysiological mechanisms for human defence, in pilots and in soccer players (Eriksen et al., 1996, 2000).

4. The Levine–Ursin stress paper (1991)

Even if Levine could not go along with the systematic formal definitions as was offered in the Ursin, 1988 paper, he and Ursin were able to formulate a theoretical paper holding most of the assumptions from that paper (Levine and Ursin, 1991).

The paper gave three consensus statements. Physical demands and psychological characteristics that produce the stress response have nothing in common. All stimuli are appraised or filtered before they gain access to the response system. The main “filters” are related to response outcome expectancy and stimulus expectancy. It is the individual’s experience of the demands and the expectancies of the outcome, which determine whether the demands will cause stress responses, which – if sustained – may cause illness and disease in man and animals.

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